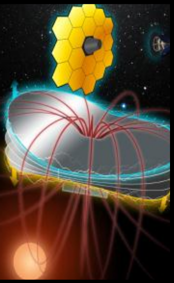
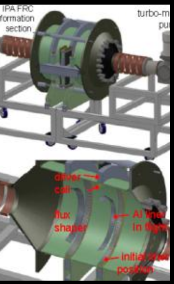
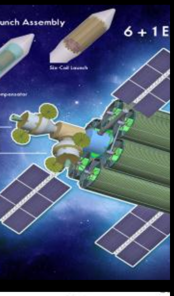
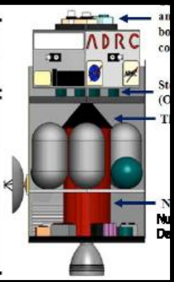






NASA INNOVATIVE ADVANCED CONCEPTS
2012 FALL SYMPOSIUM

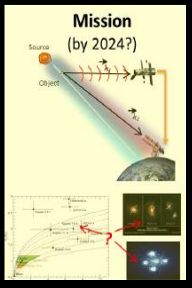
Dr. Jay Falker
Program Executive
NASA Innovative Advanced Concepts
NASA Headquarters

November 14-15, 2012
Crowne Plaza Hotel
Hampton, Virginia

NASA Innovative Advanced Concepts

www.nasa.gov/niac



KEYNOTE ADDRESS

Dr. Mason Peck

NASA Chief Technologist

"Technology and the Future"

NASA Innovative Advanced Concepts

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WELCOME BACK!

Thursday, November 15, 2012

NASA Innovative Advanced Concepts

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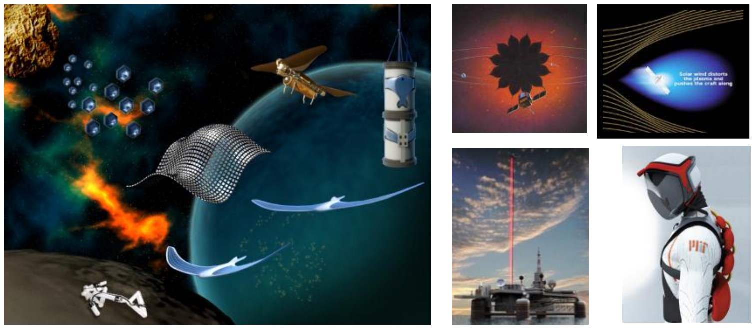
Day 2 Outline

- Keynote Address: Dr. Mason Peck
- NIAC Overview
- Phase I Introductions
- 2013 Dates & Details
- Lunch Break
- Phase II Presentations
- Phase I Poster Session

NASA Innovative Advanced Concepts

Managed at NASA Headquarters



Studies exploring revolutionary yet credible ways to expand the possibilities in aerospace

Objective: Initial study of visionary concepts

A viable NIAC *concept* must be:

- Aerospace architecture, system, or mission
- Exciting: exploring a potential breakthrough
- Credible: sound scientific/engineering basis with a reasonable implementation path

An appropriate NIAC *study* must:

- Develop the proposed concept
- Assess it in a mission context

Acquisition Strategy

- Two NASA Research Announcements (NRAs) annually:
  - **Phase 1:** To examine the overall viability of an innovative system or concept; open competition
  - **Phase 2:** To further develop the concept and assess key issues such as cost, performance, development, infusion, and business case; competitively selected from successful Phase I
- Selections are all competitive (not directed), based on peer review of all qualified proposals

Awards

- **Phase 1**: ~9 months, $100K; start ~16/year
- **Phase 2**: Up to 2 yrs, $500K; start ~6/year

Collaboration

- Proposals welcome from any US researchers; open to academia, small and large businesses, laboratories, non-profits, and US government agencies (including NASA and JPL)

PHASE I INTRODUCTIONS (Part II)

Solid State Air Purification System
Wayne Gellett, eSionic

Problem Statement

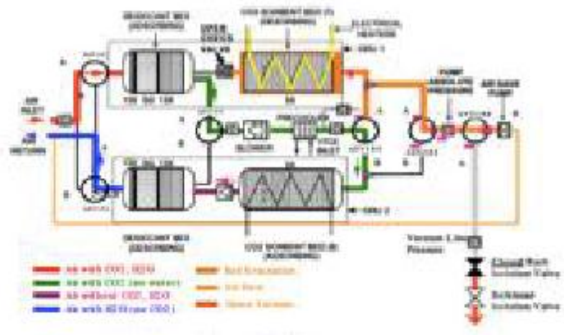
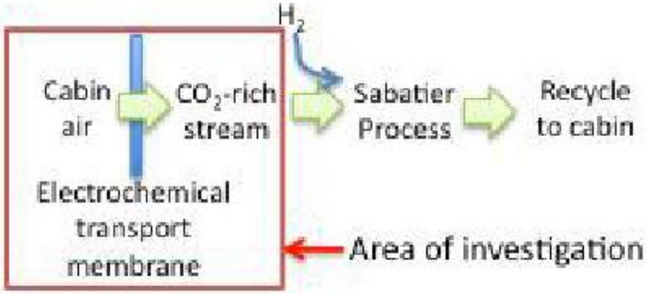


Figure 1 CDRA Schematic

Existing air revitalization system is overly complex and bulky

Solution: Continuous flow, solid state air purification system



Benefits

- High throughput with low weight, small footprint
- >10X reduction in power
- Potentially improved reliability
  - Eliminates sources of dust
  - Eliminates all compressors
  - Room temp operation
  - Continuous process

Phase I Approach

- Demonstrate electrochemical pumping of CO_2 in membrane configuration
- Present detailed trade analysis on potential costs, performance, and power use

SpiderFab: Process for On-Orbit Construction of Kilometer-Scale Apertures

Robert Hoyt, Tethers Unlimited, Inc.

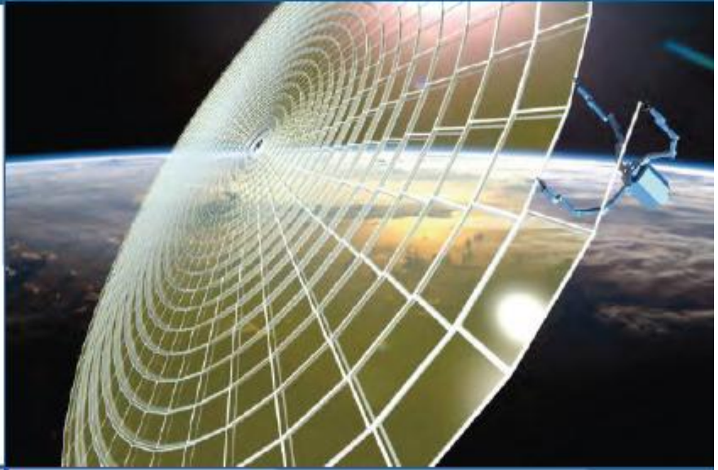
SpiderFab

Organization: Tethers Unlimited, Inc
PI: Dr. Robert Hoyt

Process for On-Orbit Construction of Kilometer-Scale Apertures

TETHERS UNLIMITED
Advanced Propulsion, Power, & Comm. for Space, Sea, & Air

- **Challenge Addressed:**
  - Currently, design, mass, & cost of space systems is driven largely by need to ensure they survive launch loads
  - Size of apertures and structures constrained by need to stow them within available fairings
- **Proposed Innovation:**
  - SpiderFab combines techniques evolved from terrestrial additive manufacturing and composite layup with robotic assembly to enable on-orbit construction of large spacecraft components optimized for the zero-g environment



- **Proposed Effort**
  - Develop architecture and concept designs for SpiderFab system to construct and integrate very large apertures
  - Evaluate ROI of SpiderFab on-orbit construction vs. current SOA deployable technologies
  - Proof-of-concept testing of candidate methods
- **Schedule**

- **Benefits**
  - SpiderFab constructs space system components with order-of-magnitude improvements in packing efficiency and structural performance, enabling NASA to deploy systems with larger apertures and baselines using smaller, lower cost launch vehicles
- **Payoff**
  - SpiderFab on-orbit construction will enable NASA science and exploration missions to collect and distribute data products with higher bandwidth, higher resolution, higher signal-to-noise, and lower life-cycle cost

A Plasma Aerocapture and Entry System for Manned Missions and Planetary Deep Space Orbiters

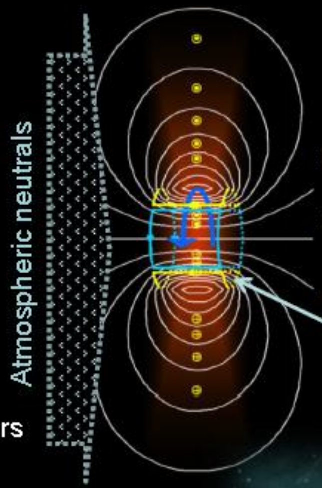
David Kirtley, MSNW, LLC

Magnetoshell Aerocapture for Manned Missions and Planetary Deep Space Orbiters

Magnetoshells decrease Risk, Cost, Launch Mass, Trip Time, and Radiation Exposure

Advantages

- Magnetoshell drag >> Aerodynamic drag
- Drag can be controlled electronically
- Fundamental physics demonstrated
- Huge Mission Delta-V Savings
- Lightweight, low-power, no superconductors



Plasma Magnetoshell

1. Rotating Magnetic Field (RMF) drives current in plasma creating a 100 m plasma dipole (Magnetoshell)
2. Shell drags on atmospheric neutrals through charge-exchange/ionization
3. Plasma is fueled and heated from captured planetary neutrals
4. Magnetoshell expands or contracts by changing RMF magnitude

Mission Impact

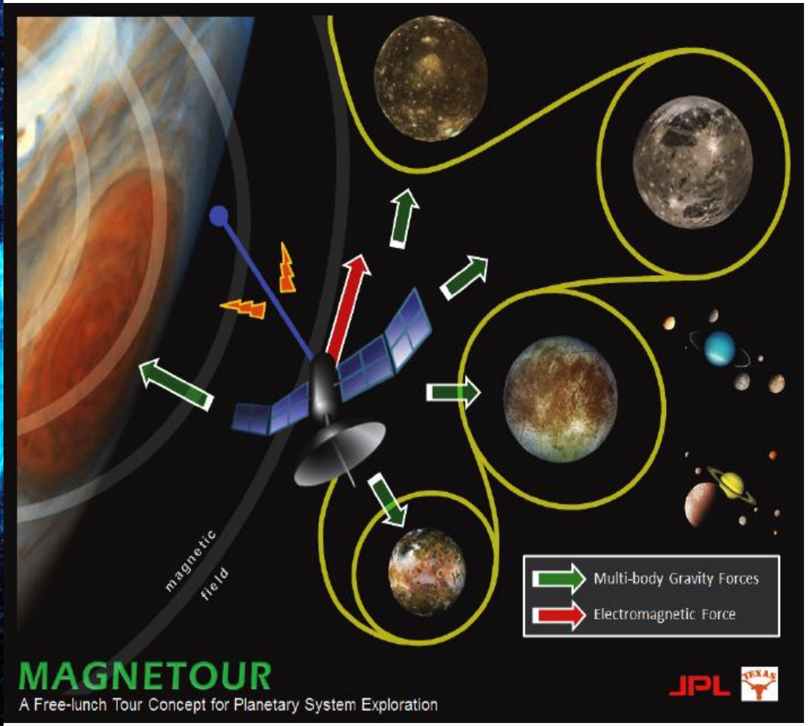
- 50% decrease in launch mass (225 mT for DRA 5)
- 70% decrease in trip time for deep space orbiters
- Manned aerocapture now feasible with decreased risk

Phase I

- *Determine key missions and payoffs*
- *Demonstrate subscale Magnetoshell drag*
- *Design end-to-end system*

MAGNETOUR: Surfing Planetary Systems on Electromagnetic and Multi-Body Gravity Fields

Gregory Lantoine, NASA JPL



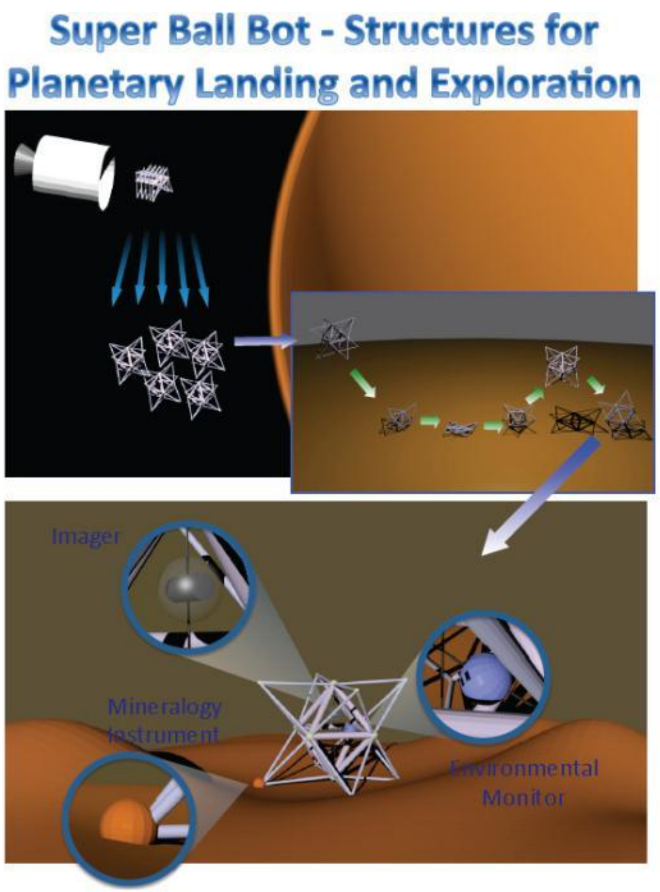
We propose a new mission concept, that enables a spacecraft to orbit and travel between multiple moons of an outer planet, using very little or even no propellant. We exploit the unexplored combination of magnetic and multi-body gravitational fields of planetary systems.

This concept involves combining two main innovations:

- Design of a very low delta-v tour of planetary moons by considering the intrinsic multi-body gravitational dynamics of planetary systems.
- Use of the electromagnetic Lorentz force as a revolutionary means for performing the required low delta-v maneuvers of our low-energy tour. This force originates from the magnetic field of the planet, and acts on moving spacecraft carrying an electrical charge, such as an electrodynamic tether.

Super Ball Bot - Structures for Planetary Landing and Exploration

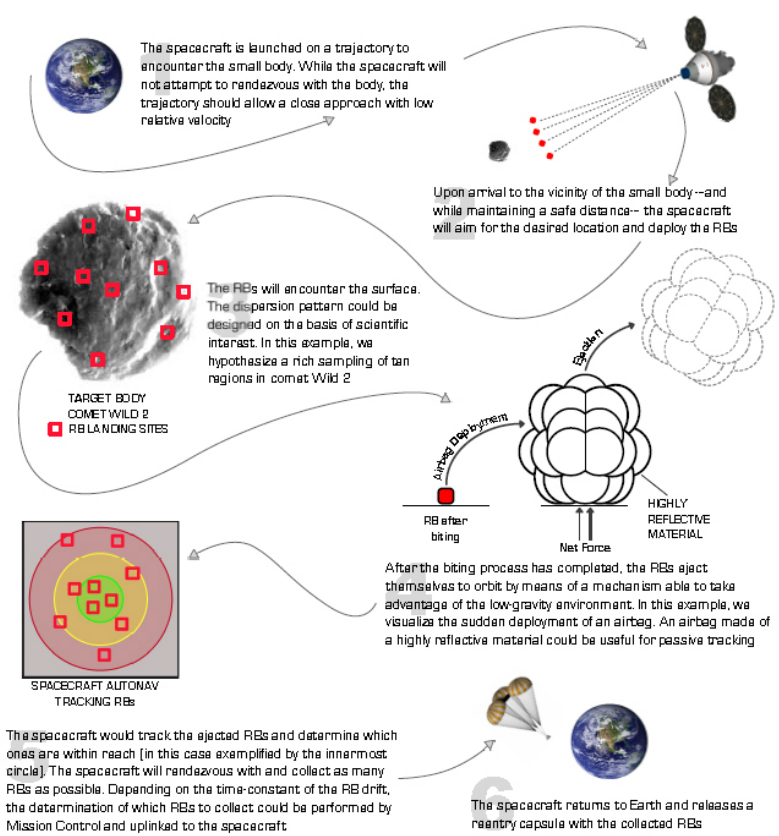
Adrian Agogino, NASA ARC



Small, light-weight and low-cost missions will become increasingly important to NASA's exploration goals for our solar system. Ideally teams of dozens or even hundreds of small, collapsible robots, weighing only a few kilograms a piece, will be conveniently packed during launch and would reliably separate and unpack at their destination. Such teams will allow rapid, reliable in-situ exploration of hazardous destination such as Titan, where imprecise terrain knowledge and unstable precipitation cycles make single-robot exploration problematic. We propose to develop a radically different robot based on a "tensegrity" built purely upon tensile and compression elements. These robots can be light-weight, absorb strong impacts, are redundant against single-point failures, can recover from different landing orientations and are easy to collapse and uncollapse.

The Regolith Biters: A Divide-And-Conquer Architecture for Sample-Return Missions

Juan Arrieta, NASA JPL



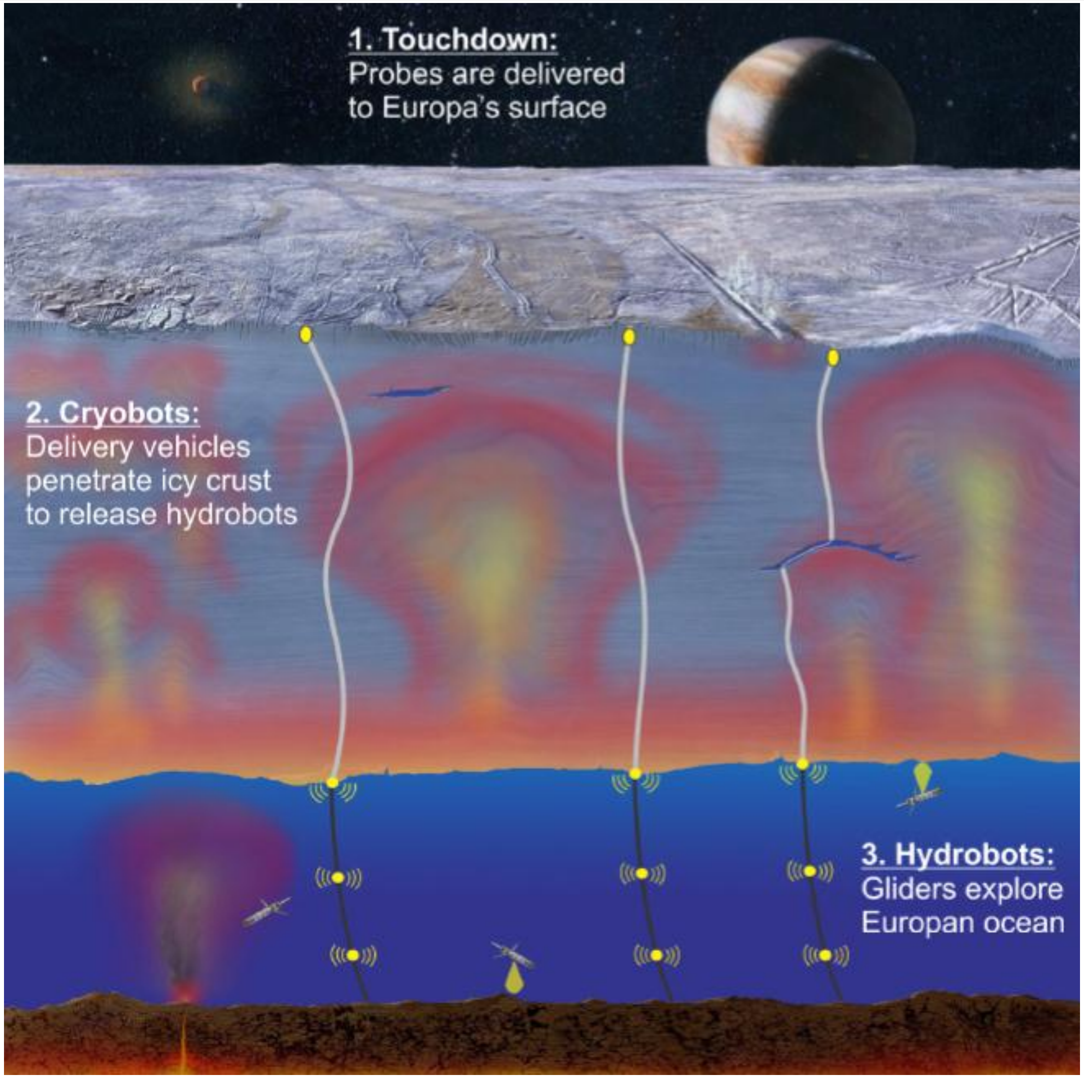
The collective interaction of simple systems can be leveraged to attain complex goals. We envision space system architectures where the core functional components are decoupled, autonomous, and cooperative.

A spacecraft carrying a number of RBs would travel to the vicinity of a small body. From a favorable vantage point, and while remaining within a safe distance in a non-colliding trajectory, it would release the RBs towards the target body. Upon encountering the body, they would bite the regolith (thus retaining a sample), and eject back to orbit. The spacecraft, with appropriate navigation and tracking capabilities, would rendezvous with and collect those RBs within its reach, and bring them back to Earth.

We want to inspire other mission designers and scientists to explore the applicability of this mindset to other domains.

Exploration of Under-Ice Regions with Ocean Profiling Agents (EUROPA)

Leigh McCue, Virginia Polytechnic Institute and State University

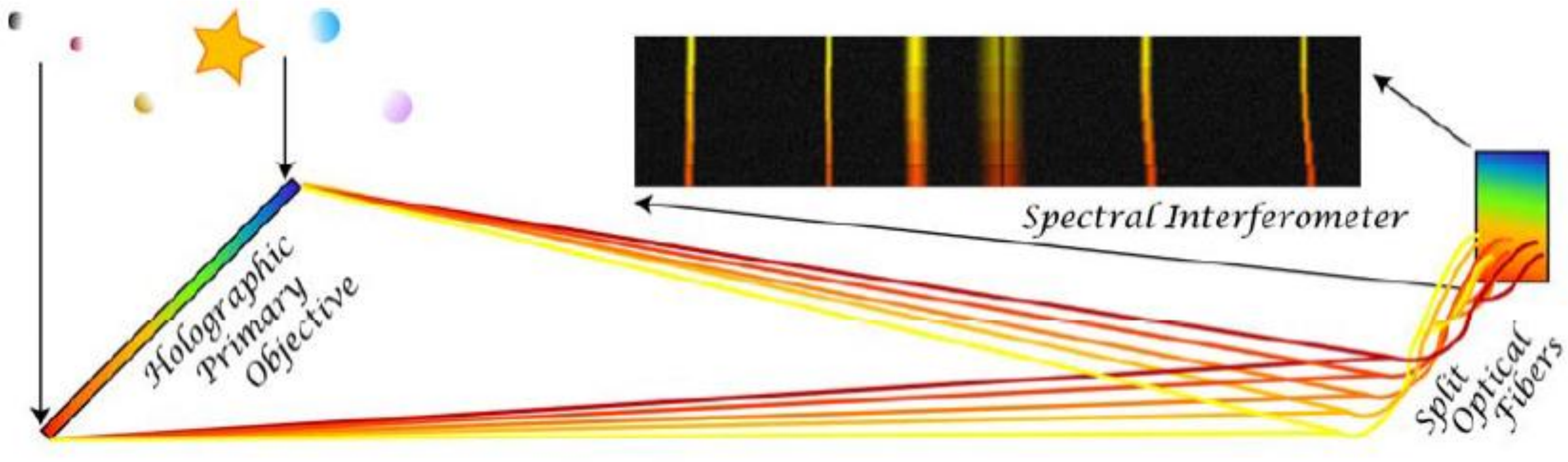


This project seeks to lay the framework for sending a team of autonomous gliders to Europa as a scientific mission to understand the physical and chemical environment of Europa's ocean.

This Phase I effort will investigate a prototype system addressing those challenges specific to exploration of Europa with gliders.

HOMES - Holographic Optical Method for Exoplanet Spectroscopy

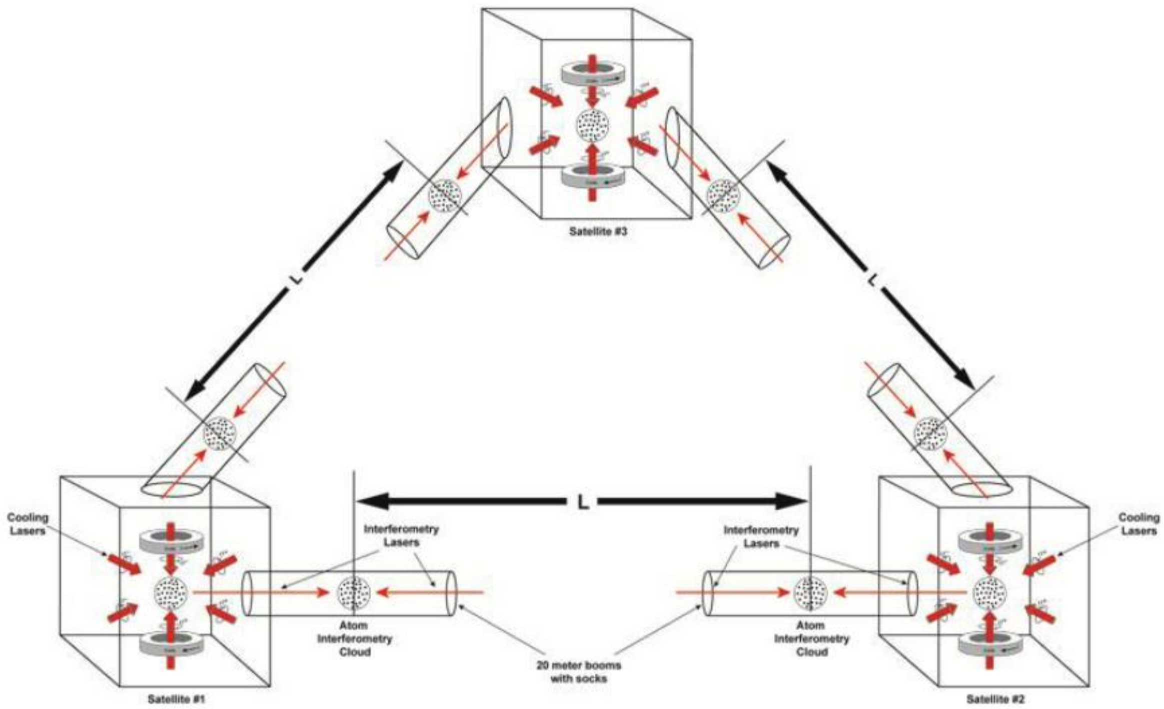
Thomas Ditto, 3DeWitt LLC



The Decadal Survey of Astronomy and Astrophysics makes it quite clear that exoplanet discovery must include a spectroscopy component. HOMES is a space telescope designed to hit all of these criteria. Its double dispersion architecture employs a holographic optical element as a primary objective in conjunction with a novel secondary spectral interferometer. Unlike mirrors and lenses, the holograms are thin and flat. They can be fabricated on thin gossamer membranes and stretched over space frames covering thousands of square meters. Holographic optics are intrinsically spectrographic providing a wealth of detail about the composition of the images they form. Add to this a novel notch filter to dim the star that takes advantage of the spectrographic image, and HOMES is a concept that addresses the demanding specifications of a telescope to find habitable planets within 30 light years of earth.

Atom Interferometry for detection of Gravity Waves-a

Babak Saif, NASA GSFC



Atom interferometers are more sensitive to inertial effects. This is because atoms in their inertial frame are ideal test masses for detection of gravity effects and gravity Waves. The internal and external degrees of freedom of atoms are used to amplify the gravity wave phase.

BREAK

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DATES & DETAILS

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Key 2013 Dates: Symposia & Site Visits

- Spring Symposium: March 12-14, in Chicago, IL
  - **Phase I presentations** on study progress
  - Phase II posters on study progress
  - We will discuss Phase II (this is before solicitation release) and answer questions

- Fall Symposium: early November, venue TBD
  - Agenda/emphasis likely much like here

- Phase II Site Visits: Sept-Oct 2013, venue TBD

Key 2013 Dates: Phase I Solicitation

- Two-Step Solicitation / Response: Jan - April
  - NASA Research Announcement (NRA) release early Jan
  - Step A White Papers due early Feb (1 month)
  - Step B invitations early March (1 month)
  - Step B Full Proposals due early April (1 month)
- Review Panels: April - June
  - Technical Review Panels complete by late May
  - Integration Panel complete by late June
- HQ Review & Announcements: July
  - Consultation for synergy/overlap with other NASA efforts
  - Official Source Selection by mid-late July
  - Announcement ASAP (all proposers receive notification)
- Goal: all awards received by mid-August
  - These will be for 9-month studies, up to $100K

Key 2013 Dates: Phase II Solicitation

- One-Step Solicitation / Response: May - July
  - NASA Research Announcement (NRA) release late May
  - Full Proposals due early July (6 weeks)*

    ** Only eligible if Phase I Final Report is received*

- Review Process: July - August
  - Technical Reviews complete by early Aug
  - Integration Panel complete by mid Aug

- HQ Review & Announcements: July
  - Consultation for synergy/overlap with other NASA efforts
  - Official Source Selection by late Aug
  - Announcement ASAP (all proposers receive notification)

- Goal: all awards received by mid-September
  - These will be for 2-year studies, up to $500K

Key 2013 Dates: Final Report Due Dates

- Phase I Studies
    - If proposing to the 2013 Phase II Solicitation, your Phase I Final Report is due by the Phase II due date (we currently anticipate July 2, 2013)
    - Otherwise your Phase I Final Report is due by the end of your study period of performance (coordinated with Jason Derleth) provided it is no later than Sept 9, 2013

- Phase II Studies
    - Your Phase II Final Report is due by the end of your study period of performance (coordinated with Jason Derleth) provided it is no later than Sept 9, 2014

Note: Phase II proposals are eligible based on any completed Phase I study (including from the original NIAC Institute). There is no penalty for waiting to propose to a later NRA, nor for re-proposing if not selected.

Phase I Deliverables

Status Reports

Brief written status reports to NASA Headquarters by the 15th day of the second month after award, and bimonthly thereafter.
[Note: to synchronize reporting, despite variable start dates, please provide your updates in: December 2012, February 2013, etc.]

Final Technical Report

A final written technical report by the conclusion of the effort, suitable for public release, detailing the concept and what it offers to NASA, the approach used to evaluate the concept, and the findings with regard to the concept's technical feasibility.

NIAC Symposium Participation

NIAC Fellow (i.e., Principal Investigator) attendance at two program meetings. The first will be to present an overview poster of the concept at a three-day NIAC Fall Symposium and the second will be to present status and preliminary findings at a three-day NIAC Spring Symposium.

NOTE: In addition to the formal deliverables, NIAC encourages you to publish in technical journals, present at technical conferences, and engage the public (and press) for outreach. Please remember to **include NASA/NIAC attribution**, and keep Kathy Reilly informed.

Phase I Final Report

All reports must be submitted as Portable Document Files (.pdf) attached to an electronic mail message.

The final report (minus proprietary appendices, if required) and the Fellows Symposium presentations must be suitable for public release …

NASA recognizes that there are cases when data cannot be disclosed in the public domain (e.g., export controlled data). Even in these cases, Proposers are expected to publish data to the greatest extent possible (e.g., use normalized data or at least discuss new methodologies used with clean "test cases.") NASA also understands that proposers may have legitimate proprietary interests in technology or data they have produced at their own expense. If results must include proprietary or restricted information, that information should be segregated into a separate appendix that will not be publicly disseminated. A publicly releasable version of the final report shall be otherwise complete and comprehensive as far as is feasible.

NOTE: The final reports are your chance to shine…they are the most visible product to communicate your findings to NASA, the public, and to your peers

Further Note on Status Reports

Routine Bi-monthly status reports are absolutely essential

(Headquarters-led program)

Bu these need not be a burden; a few paragraphs will suffice, via PDF attachment in an email to hq.niac@mail.nasa.gov

Recent accomplishments, to include short summaries of technical progress against the work plan as well as a listing of completed travel, presentations, papers

Planned activities

Issues or Concerns (if any)

For the "Over-Achievers" (which includes most or all of you)

Let us know, in separate attachments, any significant successes you may want to share early, as well as links to or copies of papers, presentations, videos, press releases, etc.

- REMINDER: **We are synchronizing the bimonthly status reports, to be provided by: Dec. 15, Feb. 15, etc.**

Phase II Deliverables (from the NRA)

Status Reports

Brief written status reports (no more than a few pages) to NASA Headquarters by the 15th day of the second month after award, and bimonthly thereafter.

Site Visit Review

Presentation at a one-day Site Visit Review to provide a thorough overview of technical and programmatic progress. This meeting will be hosted by the PI and supported as appropriate by key team members. The NASA review team will consist of NIAC program management, in addition to invited technical experts. The site visit shall be planned for approximately one year after award, but scheduling will be subject to the availability of the appropriate NASA review team. Travel costs of the NASA review team are not to be covered by the contract.

Final Technical Report

A final written technical report within thirty days of the conclusion of the effort, suitable for public release, detailing the concept and what it offers to NASA, the approach used to evaluate the concept, and the findings with regard to the concept's technical feasibility.

Annual Key Enabling Technologies Report

A written summary of identified key enabling technologies and prepare a pathway for development of a technology roadmap. Delivered to NASA Headquarters annually beginning one year after award.

NIAC Symposium Participation

NIAC Fellow (i.e., Principal Investigator) shall attend up to two program meetings per year. The first will be to present an overview of the concept at a three-day NIAC Fall Symposium and the second will be to present progress via posters at a three-day NIAC Spring Symposium.

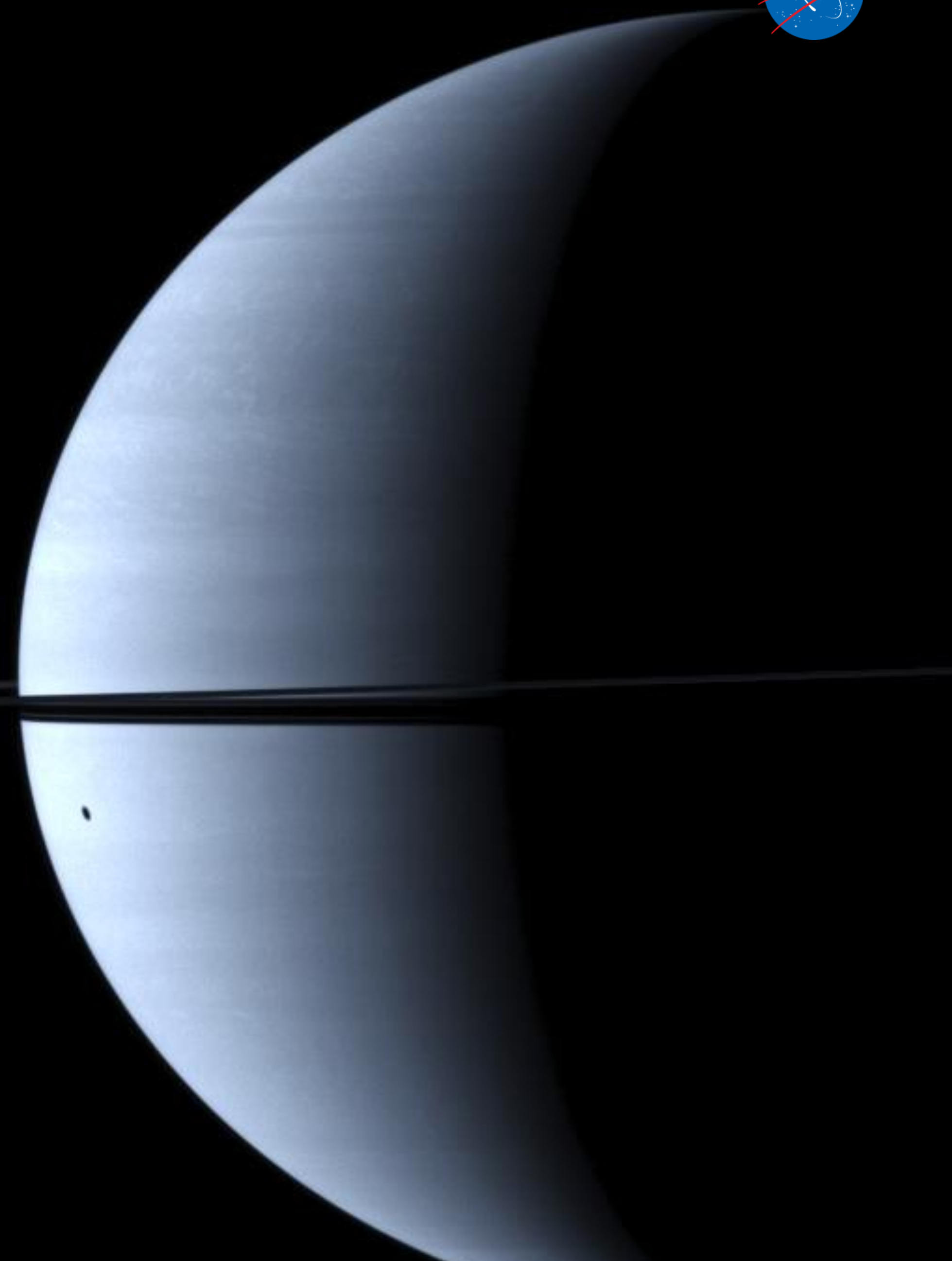
Same expectations of technical and public outreach!

Intent of Phase II Study

To study major viability issues associated with cost, performance, development time, and key technologies. Aim to provide NASA a sound basis to consider the concept for further development and a future mission. Toward that end, a Phase II study should…

- **Continue to develop the concept from Phase I** — refinements or advances identified during Phase I are expected to be incorporated, but the Phase II must be a continuation of the Phase I study.
- **Continue to assess the concept in a mission context** — the main focus should be determining viability and comparing properties/performance with those of current missions/concepts. Concepts that may support multiple missions should discuss the range, but must feature detailed analysis for at least one candidate mission.
- **Assess the programmatic benefits and cost versus performance of the proposed concept** — explore the relationships between the concept features (technology, complexity, etc.) and the projected benefits, cost, risk, and performance.
- **Develop paths forward** — identify the key enabling technologies/systems and propose steps for research, development, and demonstration

KENDRA SHORT



LUNCH

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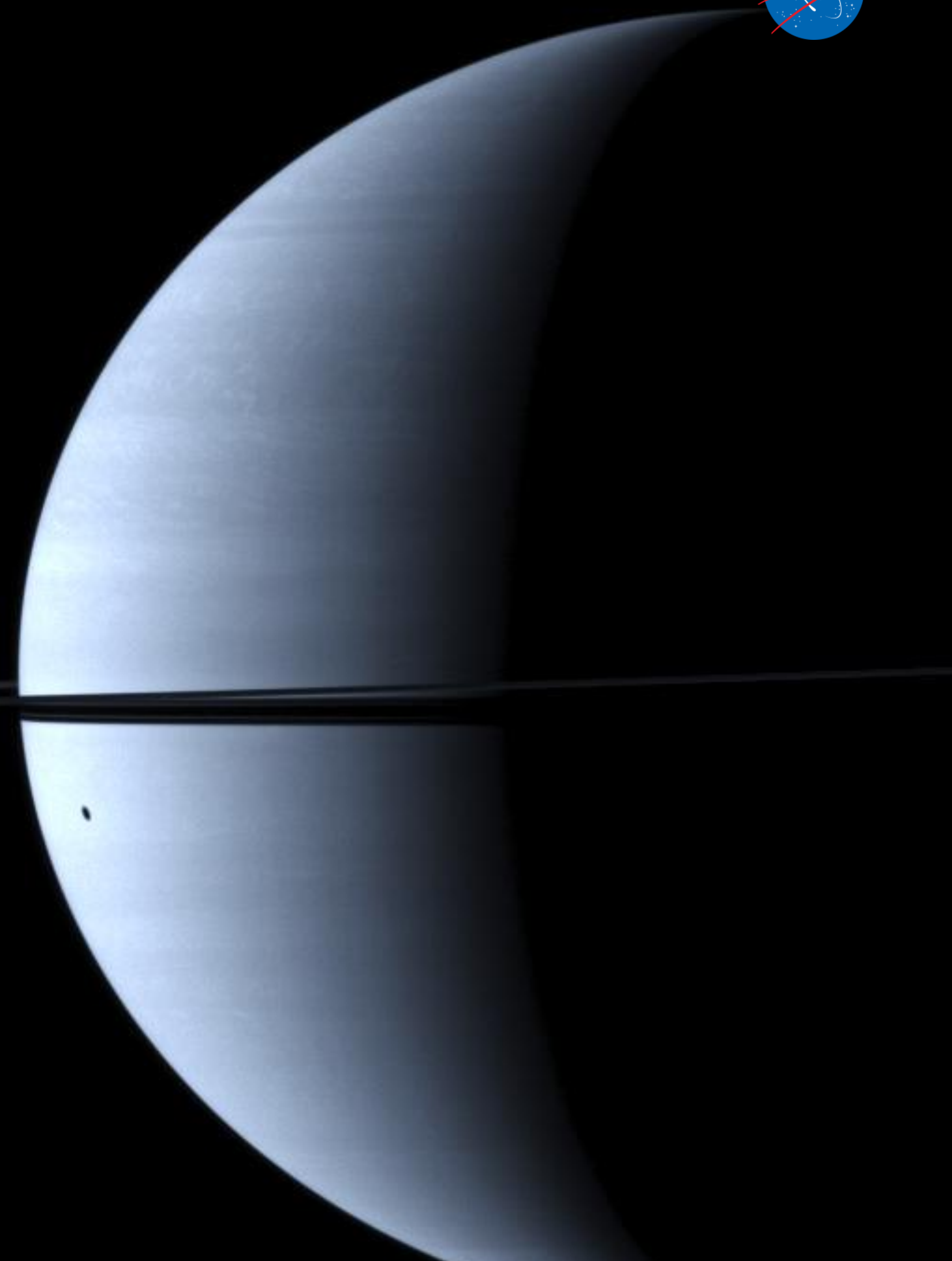
JOE RITTER

DAVID MILLER



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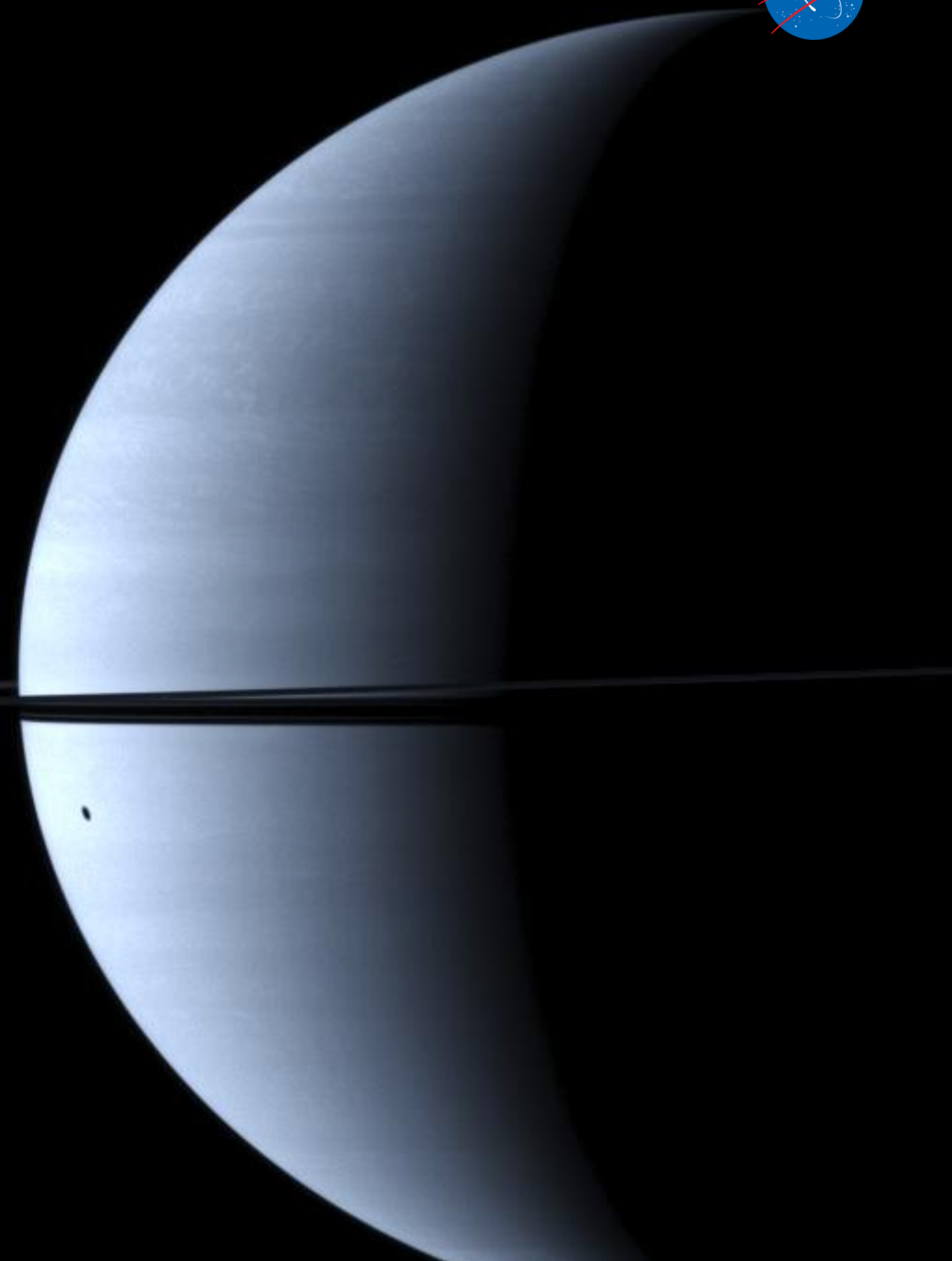
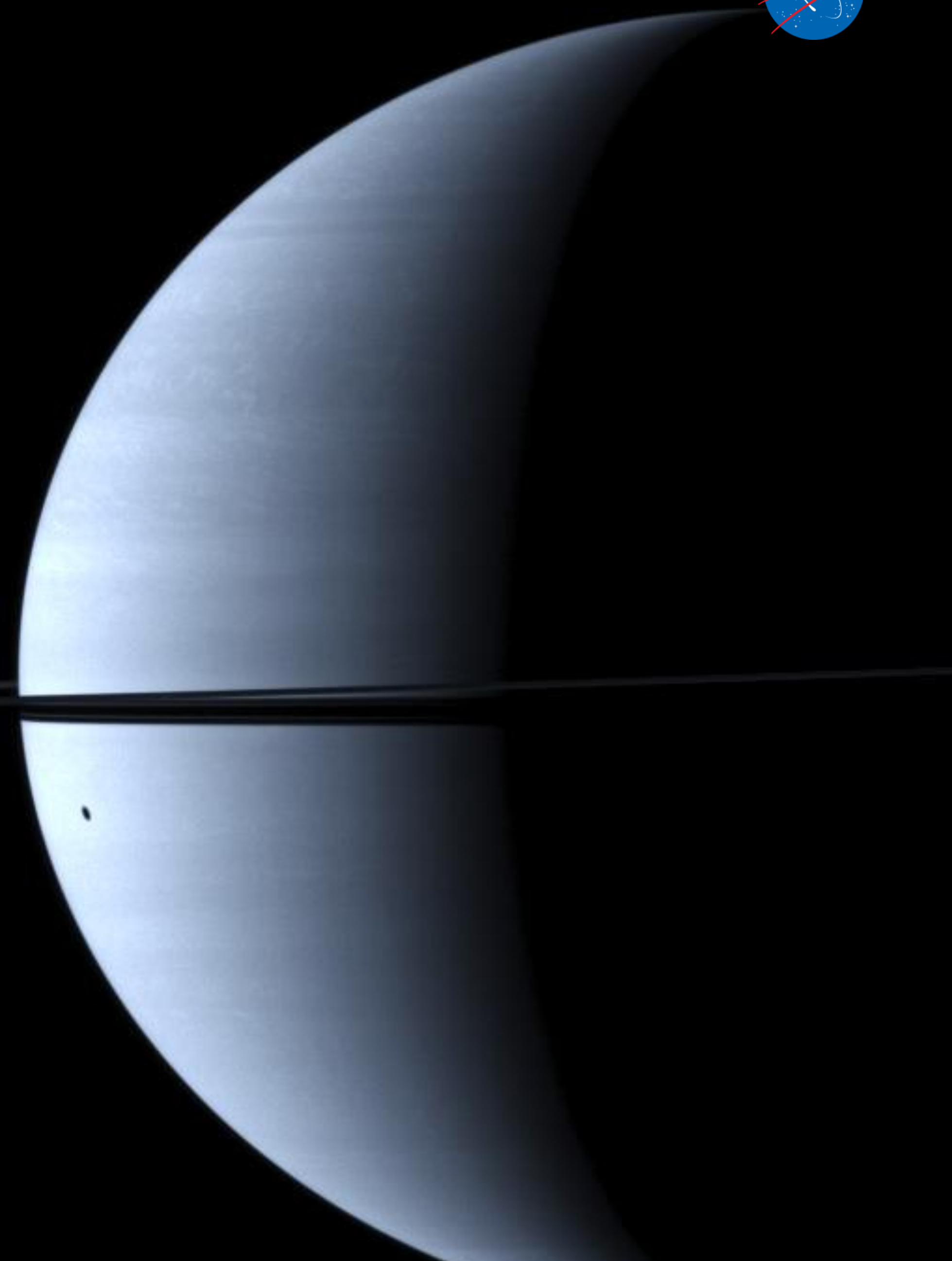
BEHROKH KHOSHNEVIS



KEVIN DUDA



POSTER SESSIONS

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Q&A

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SYMPOSIUM WRAP-UP

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